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CONCURRENT CULTURE OF SHRIMP AND TILAPIA IN THE COASTAL POND

S.B. Saha, M. Moniruzzaman and M.J. Alam

Bangladesh Fisheries Research Institute
Brackishwater Station, Paikgacha, Khulna-9280, Bangladesh

Abstract

An on-farm study with the active participation of farmer was conducted in and around Paikgacha, Khulna to validate the technique of production of shrimp (*Penaeus monodon*) and genetically improved farmed tilapia (GIFT) in concurrent culture system in the brackish water ponds. The grow-out ponds were stocked with shrimp @ 2/m^2 and GIFT @ 1/m^2 standardized for concurrent culture in the on-station study. After 65~76 days of culture, shrimps of two ponds were attacked with white spot viral disease. In the other pond, production of shrimp was 339.29 kg/ha and that of GIFT was 1777.02 kg/ha after 120 days of rearing. Cost of production in this pond was Tk. 1,35,346.00/ha with the cost benefit ratio of 1.00:2.38. Production of shrimp and GIFT in ponds with viral attack was 92.47~135.70 kg/ha and 1726.48~1782.00 kg/ha, respectively. Gross return from GIFT was higher than total cost of production in all ponds indicating that farmers will not loose investment for production in case of mass mortality of shrimp due to outbreak of viral disease. Extension of this production process with wider-scale would increase production of both shrimp and fish.

Introduction

The importance of shrimp (*Penaeus monodon*) in the development of national economy of Bangladesh is worth mentioning. Shrimp is the second largest export earning commodity of the country. But due to outbreak of white spot viral disease in 1994, the whole sequence of development of shrimp culture system has been disrupted seriously. The disease has threatened the whole shrimp culture industry in Bangladesh. As a result, the marginal farmers have lost their interest in shrimp culture. No technology has yet been developed worldwide for controlling viral disease in shrimp. Bangladesh Fisheries Research Institute (BFRI) developed culture technology of shrimp with the provision of prevention of viral disease (Saha and Alam, 2008). But this technology is not affordable by the marginal and medium scale farmers as it involves large amount of investment. To minimize the risk of loosing investment in case of mortality of shrimp due to invasion of virus in coastal shrimp farms and to develop a production technology suitable for the small and medium scale farmers, Bangladesh Fisheries Research Institute (BFRI) conducted several studies on the diversification of crops in coastal shrimp farms with different species combinations and densities of fishes (Ali *et al.* 2000; Shofiquzzoha *et al.* 2001; Anon, 2006 and 2007). Recently Alam *et al.* (2008) reported that tilapia did not exert any significant effect on the water quality and survival of shrimp in rice-shrimp rotational system. Considering availability of seed, ecological advantage and economics, the above studies indicated that genetically improved farmed tilapia (GIFT) strain of Nile tilapia (*Oreochromis niloticus*) would be the most suitable of all available salt tolerant species (e.g., Grey mullet, *Barbonymus gonionutus* and *Pangasianodon hypophthalmus*) which could be reared with *P. monodon* in brackishwater ponds. The Nile tilapia could survive and grow in poor water quality with low dissolved oxygen level (Anon, 1998). Green (1997) reported that the Nile tilapia can tolerate salinity as high as 3.6 to 4.0%, but best growth occurs at salinity below 2.0%. Hussain

(2004) suggested that commercial farming of tilapia could be an alternative in brackishwater ponds where shrimp culture collapse due to disease outbreak.

The ecological and economic aspects of shrimp-tilapia culture were being studied by different workers (Fitzsimmons, 2001; Jin *et al.* 2001; Joseph *et al.* 2001; Cruz *et al.* 2008) in different countries. They recommended that tilapia-shrimp polyculture practice would be technically feasible, economically attractive and environment friendly, if the initial capital would be affordable for the small scale farmers. Recently, BFRI standardized the stocking density of shrimp with GIFT in concurrent culture system and recommended that shrimp with more than $2/m^2$ density will not be feasible at extensive culture system (Saha *et al.* 2009). Before recommendation for wider extension, an on-farm trial with the active participation of farmers was conducted to validate the culture technique at the farmers' level.

Materials and Methods

The study was conducted in three ponds of two shrimp farms in and around Paikgacha, Khulna in 2009. The particulars of the ponds are given in Table 1. The grow-out ponds were stocked with shrimp @ $2/m^2$ and GIFT, @ $1/m^2$ after nursing as recommended for concurrent culture in the on-station studies. For nursing of post larvae (PL) of shrimp and fry of GIFT, two separate in-pond nurseries, each covering an area of 4~5% of the pond, were prepared by encircling with nylon net fastened in bamboo frame in every pond.

After drying, soil of the ponds were treated with lime (CaO) @ 250 kg/ha. Then the ponds of both farms were fed with the tidal water of a tributary of Shibsa river up to a depth of 83~100 cm. Animalcule of water was killed by applying rotenone and then dipterex @ 1.50 ppm each. Water of the ponds was then treated with dolomite @ 20 ppm and after three days, fertilized with urea @ 2.5 ppm and TSP @ 3.0 ppm. After production of sufficient plankton, required quantity of PL of shrimp (PL20) and fry of GIFT (2.65±0.15g) were stocked in the in-pond nurseries of pond # 1 on 18th March' 2009 and pond # 2 & 3 on 11th March' 2009. The area of ponds were 2000, 1308 and 1180 m^2 of ponds 1,2 and 3, respectively. After two weeks, juveniles of shrimp and GIFT were allowed to spread throughout the culture pond by opening the nursery enclosure. Shrimps were fed with commercial pellet feed (Saudi-Bangla shrimp feed) and fishes with locally formulated feed (approx. 35% protein content, consisting of a mixture of fishmeal-29%, sesame oil cake-15%, rice bran-35% and soybean meal-21%) twice daily following the technique as mentioned by Saha *et al.* (2009). After stocking, water of the ponds was treated monthly with dolomite @ 15.0 ppm and fertilized with urea @ 1.2 ppm and TSP @ 1.5 ppm. To maintain undisturbed ecology of the ponds, no water was exchanged. Only the evaporated water was replenished by tidal water after screening. Water quality parameters *viz.,* depth, temperature, salinity, pH, transparency and alkalinity were monitored at fortnightly interval. But dissolved oxygen was monitored frequently. The water quality variables were determined following standard methods as mentioned by APHA (1992). Growth of shrimp and GIFT was monitored fortnightly. Shrimps in pond # 2 and 3 were attacked with viral disease after 76 and 65 days of culture and a few dead shrimp was observed at the periphery of the ponds. At this situation, shrimp from these ponds were harvested by netting. Shrimp from pond # 1 and GIFT from all ponds were harvested after 120 days of rearing by netting followed by dewatering ponds. Growth and production were then estimated.

Results and Discussion

The recorded water quality variables are shown in Table 2 and variations of some variables are depicted in Fig 1. Variations of different water quality parameters except depth among different ponds were not remarkable. Depth of water of pond # 1 was higher (95~100 cm) in comparison to pond # 2 (75~83 cm) and pond # 3 (72~85 cm). As shown in Fig. 1a, initially transparency of water of the ponds was 32~37 cm, which increased after stocking to some extent and then gradually decreased to lowest level of 26.0~28.0 cm at the end of the culture period indicating increase in plankton production. The variation in salinity of all ponds was almost same and ranged from 8 to 16 ppt. Salinity of water was lowest during stocking and then gradually increased up to 75 days of culture. Then salinity began to decrease (Fig. 1b) with the onset of monsoon precipitation. Temperature of water of the ponds was almost same and varied from 29.5 to 34.0°C. pH of water of all ponds was always alkaline and ranged from 8.00 to 8.82. As shown in Fig. 1c, variation in concentration of dissolved oxygen among different ponds was not remarkable and the average concentration was 3.62-7.34 mg/l. The concentration of dissolved oxygen was initially higher and then began to decrease with the progress of culture period. As indicated in Fig. 1d, total alkalinity level of water of the ponds was always congenial for the culture of shrimp and fish and varied from 98.45 to 129.34 mg/l.

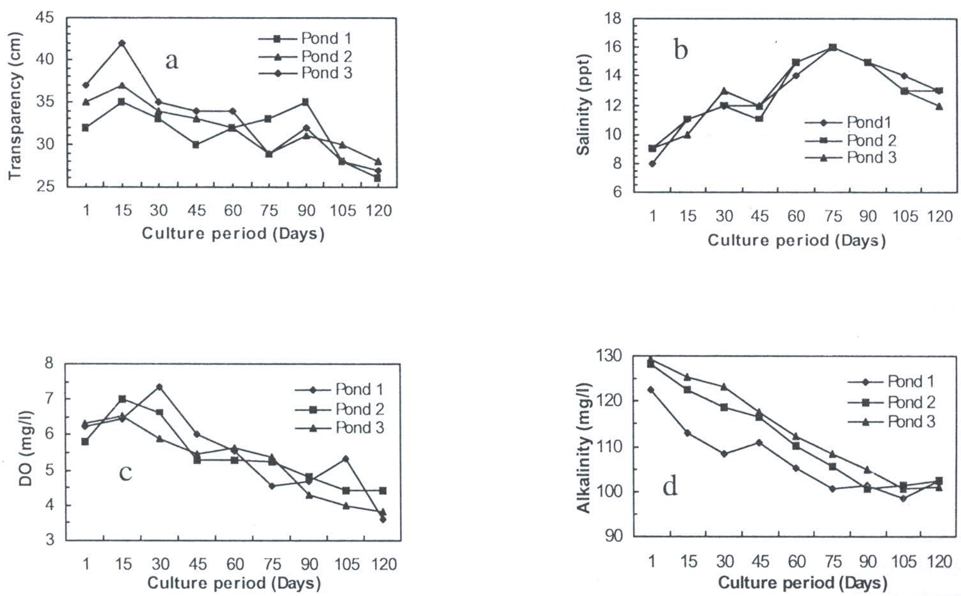

Fig. 1. Variations in some water quality variables of ponds used for concurrent culture of shrimp (*Penaeus monodon*) with genetically improved farmed tilapia (GIFT).

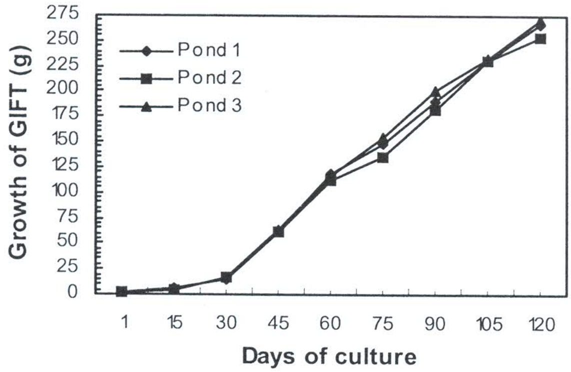

Fig. 2. Growth of genetically improved farmed tilapia (GIFT) in concurrent culture system with shrimp (*Penaeus monodon*) in the brackishwater ponds

As the growth of shrimp is concerned, it was observed that after 65 to 76 days of culture, shrimp attained an average wt. of 23.56 g, 17.46 g and 15.32 g in pond # 1, 2 and 3, respectively. The later two ponds were attacked with viral disease but no viral invasion was observed in pond # 1. After 120 days of culture, production of shrimp in pond # 1 was 339.26 kg/ha with average wt. of 23.56 g and survival of 72% (Table).

As could be seen from Fig. 2, fry of GIFT, which measured 2.65±0.15 g at the time of stocking, reached an average weight of 266.82 ± 6.72 g, 253.15 ± 5.34 g and 270.00 ± 7.74 g after 120 days of culture in pond # 1, 2 and 3, respectively, indicating no significant difference in growth of GIFT among three ponds. On the other hand, survival of GIFT was 66.60, 68.20 and 66.00% and production was 1777.02, 1726.48 and 1782.00 kg/ha in pond # 1, 2 and 3, respectively with an average production of 1761.83 kg/ha. The feed conversion ratio (FCR) of concurrent culture of shrimp with GIFT varied from 1.83, 1.72 and 1.75 in pond # 1, 2 & 3, respectively (Table 1).

Expenditure and income from concurrent culture of shrimp and GIFT are shown in Table 2. Cost of production included all variable and fixed costs needed for the culture practice and bank interest. Total cost of production in pond # 1 was highest of Tk. 1,35,346.00/ha where shrimps were not invaded with virus but lower in pond # 2 (Tk.1, 14,262.00/ha) and pond # 3 (Tk.1,12,560.00/ha), where shrimps were attacked with viral disease. The untimely earlier harvest of shrimp due to outbreak of white spot viral disease drastically reduced the production of shrimp in pond # 2 & 3. But production of GIFT in these ponds was almost same or higher than that of pond # 1. This high cost of production in pond # 1 was due to the extra cost of feed needed to rear shrimp up to 120 days. Total gross income (Tk. /ha) was highest of 3,22,291.10 in pond # 1, followed by 2,06,991.05 in pond # 3 and 2,01,823.50 in pond # 2. Similar trend was followe where net return (Tk./ha) was 1,86,945.10, 87,561.50 and 94,431.05 with the cost benefit ratio (BCR) of 2.38, 1.77 and 1.83 in pond # 1, 2 & 3, respectively. The highest gross return from pond # 1 was due to highest production and market price of shrimp in comparison to other ponds. Saha *et al.* (2009) also reported a production of 289.43 kg/ha shrimp and 1457.04 kg/ha GIFT with the net return of Tk.1,22,145.00 /ha in concurrent culture of shrimp @ 2 m^2 density and GIFT @1 m^2 density in the on-station ponds.

Table 1. Poduction performance of shrimp (*Penaeus monodon*) and GIFT in concurrent culture system in the brackish water ponds

Ponds	Species	Initial weight (g)	Growth 65-75 days of culture (g)	Survival (%)	Production (kg/ha)	** FCR
1	Shrimp	0.006	23.56	72.00	339.26	1.83
	GIFT	2.65	266.82	66.60	1777.02	
2	Shrimp	0.006	17.46	38.86	135.70	1.72
	GIFT	2.65	253.15	68.20	1726.48	
3	Shrimp	0.006	15.32	30.18	92.47	1.75
	GIFT	2.65	270.00	66.00	1782.00	

* Shrimp attacked with viral disease after 65~76 days culture
** FCR, feed conversion ratio

Table 2. Expenditure and income from concurrent culture of shrimp (*Penaeus monodon*) with genetically improved farmed tilapia (GIFT)

Ponds	Species	Total cost* (Tk./ha)	Gross return (Tk./ha)	Net return (Tk./ha)	**BCR
1	Shrimp	1,35,346.00	S = 135704.00	1,86,945.10	2.38
	GIFT		F =186587.10		
			Total = 3,22,291.10		
2	Shrimp	1,14,262.00	S = 29175.50	87,561.50	1.77
	GIFT		F =172648.00		
			Total = 2,01,823.50		
3	Shrimp	1,12,560.00	S =19881.05	94,431.05	1.83
	GIFT		F =187100.00		
			Total= 2,06,991.05		

* Cost of land lease, embankment repair, piscicide, shrimp & fish seed, feed, fertilizer, lime, bamboo, labour, nylon net, minor tools, harvest and bank interest.
** Benefit-Cost Ratio (S= Shrimp; F= GIFT). Pirce: Shrimp, Tk.400/kg, GIFT, Tk. 215/kg

However, the cost benefit analysis indicates that gross return from sale of GIFT over total gross return was 85.54, 91.01 and 57.89 % in pond # 1, 2 & 3, respectively, which were higher than the total production cost. The result indicated that even after total mortality of shrimp caused by viral infection, farmers would not loose the investment if GIFT would be stocked with shrimp as also reported by Saha *et al.* (2009). If there be no outbreak of disease in shrimp, the cost benefit ratio would be higher than that of 1.88 as reported by Saha *et al.* (2006-07) in semi-intensive culture of shrimp, where production of shrimp was about 1700 kg/ha and cost of production was more than taka five lakhs/ha. An earlier study also indicated that addition of tilapia would not significantly affect the production of shrimp in concurrent culture system (Anon, 2007). Moreover, net return from shrimp-tilapia concurrent culture system was higher than that of monoculture of shrimp at the same stocking density. Akiyama and Anggawati (1999) reported that yields of shrimp increased when tilapia were stocked into shrimp ponds. They also mentioned that tilapia assist shrimp performance by improving and stabilizing the

water quality, by foraging and cleaning the pond bottom, and by having a probiotic type of effect in pond environment. In extensive system very less preventive measures are taken to prevent viral disease in pond, so there is risk of mass mortality of shrimp due to outbreak of disease. So, monoculture of shrimp in extensive system will no way assure a profitable harvest but there is every possibility of loosing investment by the mass mortality, which may discourage farmers for future stocking of shrimp into the pond.

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